

STUDIES ON THE TAXONOMY, MORPHOLOGY,  
AND LIFE HISTORY OF *RHABDOCHONA*  
*SPP.* (NEMATODA: SPIRUROIDEA)

BY  
PAUL VICTOR GUSTAFSON  
B.S., Whitworth College, 1936  
M.S., University of Illinois, 1937

AN ABSTRACT OF A THESIS  
SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS  
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN  
ZOOLOGY IN THE GRADUATE SCHOOL OF THE  
UNIVERSITY OF ILLINOIS, 1942

URBANA, ILLINOIS  
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Since the fall of 1937, an investigation has been in progress on the life histories of species of *Rhabdochona*. Simultaneously, identification of the forms encountered was undertaken, along with a survey of the fundamental anatomy of the group, with special reference to points of doubt or controversy in previous publications.

Life-cycle investigations subjected the suspected intermediate hosts to *Rhabdochona* eggs for 24 to 48 hours, then removed them from the source of infection to a permanent vessel until dissected. Precautions were taken to observe the position of the parasite in the host. Larval stages discovered were studied alive, or fixed and mounted permanently.

Morphological investigations were carried out with living specimens and permanent mounts. Formal-acetic-alcohol was used as fixative. Total mounts were stained with Delafield's hematoxylin or Semichon's acetic-carmin, and mounted in balsam, clarite, or glycerine jelly. Several serial sections, of both males and females, have been made. Face-view preparations and ventral views of males have been used for study of the details of structures concerned.

A large number of experiments with *R. decaturensis* was necessary to find an intermediate host. Development failed to follow ingestion by amphipods and several other types of crustacea, or by some kinds of mayfly nymphs and other insect larvae. Hatching and growth were found to occur in *Hexagenia* spp.; these were used for larval developments. Similarly, *R. cotti* was found to utilize several species of mayfly and stonefly nymphs as intermediate hosts. By a series of experiments, these species were artificially developed to an age of a few months. Natural infections of *R. cascadiella* were found and studied; these were advanced stages, offering an opportunity not easily duplicated experimentally.

## SUMMARY AND CONCLUSIONS

1. Life cycle studies with *R. decaturensis* have shown that development of the larvae occurs readily in *Hexagenia* spp. Many attempts to implicate other genera of mayflies, and many other insects and crustaceans have failed. Hatching and development have not been seen to occur in any other circumstances.

2. The development of this species follows the usual course for spirurids through the first three stages. The first stage larva is equipped with subterminal cuticular tooth and long filiform esophagus. It migrates to the body cavity, more than doubling its length and increasing in thickness until it resembles the sausage form of filaria. The first molt, probably about eight days after infection, is followed by extensive growth and maturation. The genital organs make their appearance and sexes can be distinguished by the end of the second period. Generic characteristics are prominent. The second molt, after about 21 to 25 days, is followed by an encapsulation. Further growth continues in the cyst.

3. A precocious development during which more ecdyses occur may follow. In one experiment in which the mayfly was examined over seven months after infection, three males were recovered which appeared to be mature in all visible characteristics. The species could easily be identified. The spicules and papillae were of a normal adult character, and the internal organs had assumed a similar appearance.

4. Specimens taken from fish show that a large proportion are immature. The smallest and least mature of these do not show specific characteristics. One attempt to feed larvae of an early third stage indicate that perhaps these are infective at that time.

5. Experiments using *R. cotti* give results paralleling those for *R. decaturensis*. Development will occur in various species of mayfly and stonefly nymphs; *Caenis*, *Ephemerella*, and *Paraleptophlebia* have been infected most successfully. Development is slower, probably because of the temperature factor. The first molt occurs about 20 days, and the sec-

and molt about two months, after infection. The size and organization of this species is much better for detailed study of the larvae.

6. Natural infections of *R. cascadilla* were found in *Hexagenia* sp. in the Embarrass river south of Urbana, Ill. These were all encysted when examined; some were early third stage larvae, while others were surprisingly mature. Several males with spicules and papillae mature and well-formed sperms visible were recovered. Two females showed unfertilized ova in the uterus. Experiments in which these mayfly nymphs were fed to bullheads indicate that these stages are infective.

7. Initial experiments with *R. pellucida* indicate that the intermediate hosts for *R. cotti* do not serve in this capacity for both species.

8. During the course of this investigation, four species of *Rhabdochona* have been encountered. Three of these were previously undescribed, and have been described as new species; they are *R. decaturensis*, and *R. cotti*, and *R. pellucida*. The fourth, *R. cascadilla* Wigdor, 1918, has been re-described.

9. The investigation of the identity of these species disclosed the variation of characters commonly used for specific distinction. It was considered advisable to review the genus from the literature, listing all the species in chronological order with a brief, consistent diagnostic description of each.

10. As a basis for the description of these and later new species, a discussion of some of the fundamental anatomical features of the species observed is given. Emphasis was placed on points of controversy between previous writers. Many of these were found to be of value in the separation of species. The spicules and pattern of the papillae in the male, the vagina in the female, the eggs and their filaments, the stoma, and the variations of the esophagus were considered useful for specific determinations. The ratio of shaft to blade in the longer (left) spicule was suggested as a new characteristic for identifications in this group. Comparisons

among the five species observed showed this to be a feature easily measured and quite consistent for each species. The pattern of the papillae is such that it is best studied from a ventral view. This technique shows a constant pattern of the postanal papillae of five subventral pairs and one lateral pair. One lateral pair is also seen near the third subventral preanal pair. Those papillae farther anterior were seen to be asymmetrical, with the right member of the pair more anterior than the left.

## VITA

Paul Victor Gustafson was born in Mead, Washington, on February 27, 1914. He attended various elementary schools in Montana, Washington, and Oregon, and was graduated from the Lewis and Clark High School in Spokane, Washington, in June, 1931. From 1932 to 1936 he attended Whitworth College, Spokane, Washington, completing his work there with the degree of Bachelor of Science, magna cum laude. The following year was spent in the Graduate School at the University of Illinois, securing a degree of Master of Science in June, 1937. He continued work there towards a Ph. D. degree from 1937 to 1939. During the summer of 1937, he attended a summer session at Hopkins Marine Station, Pacific Grove, California, and in the summer of 1938, engaged in similar work at the University of Michigan Biological Station near Cheboygan, Michigan.

While in attendance at Whitworth College, he was appointed student assistant in the Department of Biology from 1934 to 1936. In 1936 he received an appointment as assistant in the Department of Zoology of the University of Illinois, which he maintained until August, 1939. At that time he accepted an appointment to teach in the Biology Department at Whitworth College, remaining there since. For the summer of 1940 he accepted a temporary position in the Biology Department of Lewis Institute, Chicago.

At Whitworth College he was elected to Phi Alpha in 1935. In 1938 he was elected to associate membership in Sigma Xi. He is a member of the Society of American Parasitologists, the American Association for the Advancement of Science, Gamma Alpha, the American Association of University Professors, and the Northwest Science Association.

Durin the years 1941 and 1942 he has been recipient of research grants from the Northwest Science Association for study of the parasites of fresh-water fish of the Spokane area.



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